Classification of Human Ovarian Tumors

by Robert E. Scully*

Most human ovarian tumors are classified into one of several categories based on presumed histogenesis and direction of differentiation. Separate categories are reserved for neoplasms composed of cells of several origins and for nonneoplastic disorders that simulate neoplasms. Using the World Health Organization Histologic Classification of Ovarian Tumors, histologic features for common and rare human ovarian tumors are described and illustrated.

Introduction

Human ovarian tumors are divided into three major categories, which are named according to their presumed histogenesis and directions of differentiation: common epithelial tumors; sex cord-stromal tumors; and germ cell tumors (1). A minority of ovarian tumors are classified separately either because their histogenesis is uncertain, their cellular components are of several origins, or they are nonspecific tumors that also occur at other sites. A final category of lesions that merit consideration in a discussion of ovarian tumors are various nonneoplastic disorders that simulate neoplasms on gross and sometimes on microscopic examination. The World Health Organization Histological Classification of Ovarian Tumors is presented in Appendix 1 (2).

Common Epithelial Tumors

Epithelial tumors, which account for approximately two-thirds of all ovarian tumors, and the malignant forms, which account for almost 90% of ovarian cancers, are thought to be derived for the most part from the surface epithelium of the ovary. This lining is not a true epithelium but modified pelvic mesothelium that has the appearance of epithelium as it is reflected over the surface of the ovary (Plate 1). This tumor has a potential to differentiate in a variety of epithelial directions that simulate the diverse avenues of development of mullerian duct epithelium. Although some common epithelial tumors grow exophytically directly from the surface epithelium, most of them appear to be derived from invaginations of the epithelium into the ovarian cortex, the so-called surface epithelial inclusion glands and cysts (Plate 2). These structures may be seen at any time during the life of the female but are most frequently encountered in older women. Common epithelial tumors are divided into five main categories according to the

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type of cell into which they differentiate: a) serous tumors (Plate 3), whose cells resemble those of the fallopian tube; b) mucinous tumors (Plate 4), whose cells mimic those of the endocervix; c) endometrioid tumors (Plate 5), whose cells are similar to those of the endometrium; d) clear-cell tumors (Plate 6), whose cells resemble those of endometrial epithelium during pregnancy; and e) Brenner tumors (Plate 7), whose cells are urothelial in appearance. There are also mixed forms, in which there is more than a minor additional component of a second or third cell type; unclassified forms; and undifferentiated carcinomas, whose cells cannot be specifically identified.

The first six categories of these neoplasms are further divided according to three criteria, two of them architectural, and the third related to the degree of differentiation of the tumor. Some tumors, particularly those in the serous category, may be exclusively exophytic and are referred to as surface papillary tumors. More often, common epithelial tumors are endophytic, with the neoplastic cells lining intraovarian cysts or forming intraovarian solid tumors. Not infrequently, especially in the serous group of tumors, exophytic and endophytic components coexist. Most common epithelial tumors have a stromal component derived from the ovarian stroma; it is usually fibromatous, but may be thecomatous and may produce steroid hormones of a variety of types. When the stromal component of the tumor predominates, the term adenofibroma preceded by the neoplastic cell type is used (Plate 8); if the glandular element of such a tumor is grossly cystic, it is designated a cystadenofibroma. The Brenner tumor is the only common epithelial tumor that characteristically has a predominant stromal component; the terms adenofibroma and cystadenofibroma, therefore, are not applied to this neoplasm.

The third criterion by which the common epithelial tumors are subdivided is their degree of differentiation, which is reflected in their clinical behavior. Although tumors in most organs are classified as benign or malignant, subsets of ovarian common epithelial tumors in

the first six categories have been recognized that are intermediate in their degree of morphologic differentiation and exhibit clinical behavior between obviously benign and obviously malignant tumors (Plate 9). These neoplasms, which have been designated proliferating tumors, carcinomas of low malignant potential, or borderline tumors, are characterized by a proliferation of the neoplastic epithelium greater than that encountered in benign neoplasms of the same cell type, but these tumors lack destructive invasion of the stromal component of the specimen (Plate 10). The strikingly better prognosis of borderline serous and mucinous tumors in comparison to invasive tumors in the same cellular categories justifies the separate classification of these two types of neoplasms. Borderline tumors in the other four major categories of common epithelial neoplasia are so rare that their clinicopathological features have not been clearly delineated at the present time. Although the designation of common epithelial tumor is based on the frequency and presumed histogenesis of the tumor, it is possible that some tumors in this category have other origins. For example, there is evidence that some mucinous tumors are of germ cell derivation, and their development may reflect monodermal differentiation of a teratoma. Likewise, there is evidence that some Brenner tumors are of germ cell origin, and that others may arise from the rete ovarii, the vestigial homologue of the rete testis. Nevertheless, all the tumors in these two categories are classified as common epithelial tumors because they may be admixed with other forms of common epithelial neoplasia and their general epidemiologic features suggest a close kinship to common epithelial tumors in general.

Sex Cord-Stromal Tumors

Sex cord-stromal tumors, which account for about 6% of all ovarian tumors, are derived from the sex cord and stromal components of the developing gonad. The embryonic sex cords develop into Sertoli cells in the testis and granulosa cells in the ovary, and the stroma or mesenchyme develops into the Leydig cells of the testis, the theca and stromal lutein cells of the ovary, and the fibroblasts that may appear in the stroma of either gonad. Therefore, tumors in the sex cord-stromal category may contain one or more of a variety of cell types: granulosa cells, theca cells, lutein cells, Sertoli cells, Leydig cells, and fibroblasts, in varying combinations. The most common tumor in the sex cord-stromal category, which accounts for 4% of human ovarian tumors, is the fibroma, which is composed entirely of fibroblasts forming collagen (Plate 11). Next in frequency is the granulosa cell tumor, generally a estrogenic neoplasm, which may be composed almost exclusively of granulosa cells, but more commonly contains theca cells, lutein cells, and/or fibroblasts as well (Plate 12). Granulosa cell tumors have been divided into adult and juvenile forms, which differ in their age distribution and morphologic features (3). Thecomas (Plate 13) are composed exclusively or almost exclusively of stromal cells that

have differentiated in the direction of theca cells or lutein cells. These tumors are usually estrogenic, but a small minority of tumors in the luteinized thecoma subcategory are androgenic.

Pure Sertoli cell tumors are rare; they may be associated with estrogenic manifestations, presumably due to estrogen secretion by the neoplastic cells. The more common Sertoli-Leydig cell tumors are composed of cells resembling Sertoli cells, Leydig cells, and fibroblasts in varying combinations and degrees of differentiation. The terms androblastoma and arrhenoblastoma have also been used for this group of neoplasms, but these terms erroneously connote invariable virilizing manifestations. Sertoli-Leydig cell tumors are subdivided into well-differentiated forms (Plate 14), tumors of intermediate differentiation, poorly differentiated tumors, and a fourth, heterologous type that is very interesting from the viewpoint of histogenesis. The fourth group of tumors, which account for approximately 20% of all Sertoli-Leydig cell tumors, contain, in addition to their Sertoli-Leydig cell component, various heterologous elements, most commonly mucinous epithelium of gastrointestinal type and carcinoid epithelium, but occasionally, cartilage and skeletal muscle. The histogenesis of this complex form of Sertoli-Leydig cell tumor is unclear. Most pure Leydig cell tumors of the ovary arise from the hilus cells, or hilar-Leydig cells, which have the morphologic features of testicular Leydig cells and can be found in the ovarian hilus in more than 80% of adult women. These tumors are classified under the category of steroid cell tumors (lipid cell tumors) because they may be difficult or impossible to differentiate histologically from ovarian tumors of other steroid cell types.

Tumors in the sex cord-stromal category exhibit a morphologic spectrum. Rarely, these tumors show clear-cut bidirectional differentiation and are referred to as gynandroblastomas. A larger number, however, have features intermediate between granulosa-theca cell and Sertoli-Leydig cell tumors and have been designated sex cord-stromal tumors, unclassified.

One distinctive form of intermediate sex cord-stromal tumor is the sex cord tumor with annular tubules (4). This neoplasm has a histologic pattern that lies midway between that of a granulosa cell tumor and a Sertoli cell tumor, although Charcot-Bottcher filaments, thought to be characteristic of Sertoli cells, have been found in the cytoplasm of the neoplastic cells in some cases. Sex cord tumorlets with annular tubules are found in the ovaries of the great majority of patients with the Peutz-Jeghers syndrome (gastrointestinal polyposis; oral and cutaneous melanin pigmentation; and adenoma malignum of the cervix in occasional cases).

Sex cord-stromal tumors show wide variations in degrees of differentiation from benign to highly malignant. It is difficult to separate sharply the benign from the malignant subtypes within the granulosa-cell tumor category, but the correlation between the degree of differentiation of the neoplasm and the prognosis is close in the Sertoli-Leydig cell group of tumors.

Steroid Cell Tumors

Steroid cell tumors are composed more or less exclusively of cells of steroid type that resemble lutein cells, Leydig cells, and adrenal cortical cells (Plate 15). The neoplastic cells may be lipid-free or lipid-rich. Tumors containing predominantly lipid-rich cells have been designated lipoid cell tumor, lipid cell tumor, adrenal rest tumor, or adrenal-like tumor. Some small steroid cell tumors are situated within the ovarian stroma and appear to have arisen from it; such tumors have been called stromal luteomas. Probably many of the larger steroid cell tumors also originate from the ovarian stroma. Other steroid cell tumors contain crystalloids of Reinke and on that basis can be diagnosed as Leydig cell tumors. Since Leydig cell tumors of the testis contain crystalloids in only 40% of the cases, probably a number of steroid cell tumors lacking these inclusions are also of Leydig cell origin. Although a few steroid cell tumors have been associated with Cushing's syndrome, none of them has been clearly demonstrated to arise from adrenal rests, which have been reported to be present in the broad ligament in more than 25% of women. Steroid cell tumors are usually virilizing, but may be endocrinologically inert or estrogenic. As many as one-quarter of steroid tumors exhibit malignant behavior.

Germ Cell Tumors

Since germ cells are totipotential, it is not surprising that a very wide variety of neoplasms may develop from them. These tumors account for 25 to 30% of all ovarian tumors, with the great majority of them within the category of mature cystic teratoma or dermoid cyst, the most common variety of ovarian neoplasm in the human.

Several varieties of primitive germ cell tumor recapitulate stages in embryonic development. The most common of these tumors is the dysgerminoma (Plate 16), the female homologue of the testicular seminoma, which is composed of an array of primitive germ cells that resemble closely both cytologically and histochemically the primordial germ cells of the embryo. One of the most highly malignant forms of primitive germ cell tumor is the endodermal sinus tumor or yolk sac tumor, which recapitulates yolk sac development. This tumor characteristically contains single papillary projections with central blood vessels protruding into a network of spaces lined by primitive neoplastic cells (Plate 17). These papillary units, or Schiller-Duval bodies, have been likened to the endodermal sinuses of the labyrinthine rodent placenta, which are diverticula of yolk sac endoderm that dissect into the extraembryonic mesenchyme. This resemblance has given rise to the designations endodermal sinus tumor and yolk sac tumor. In addition to recapitulating the extraembryonic development of the yolk sac, these tumors can also exhibit embryonic endodermal differentiation, with the formation of mucinous glandular structures and cells resembling hepatocytes. A subtype of yolk sac tumor that has been designated hepatoid closely resembles a hepatocellular carcinoma (5). Yolk sac tumors of all types characteristically produce α-fetoprotein, which can be stained immunocytochemically in the cells and detected at high levels in the patient's serum.

The embryonal carcinoma is a very rare tumor that resembles the embryonal carcinoma seen in the testis of adult males. It almost always contains isolated syncytiotrophoblast cells and is typically associated with elevated levels of chorionic gonadotropin (HCG) in the serum, often accompanied by endocrine manifestations, such as sexual precocity. Even more rare is the choriocarcinoma of germ cell origin, which is composed of cytotrophoblast and syncytiotrophoblast and is typically associated with similar endocrine disturbances. The polyembryoma is another extremely rare ovarian tumor composed predominantly or exclusively of multiple embryos. Since such a tumor contains elements from all three germ-cell layers, it can be regarded as the most primitive form of ovarian teratoma. Because it often contains syncytiotrophoblast, it is also capable of producing human chorionic gonadotropin (hCG) with accompanying endocrine changes.

Ovarian teratomas are a complex group of tumors that have been subdivided into three major categories: immature, mature, and monodermal and highly specialized. Immature teratomas contain at least some immature elements, most often neuroectodermal (Plate 18), but may contain varying quantities of mature tissue as well. These neoplasms are predominantly solid, with a small cystic component in most cases, but are predominantly cystic in other cases. Mature teratomas are composed exclusively of mature tissues (Plate 19); rarely, they are predominantly solid, but much more often they are predominantly cystic in the form of a dermoid cyst. This tumor is so designated because its principal component in the great majority of cases is cutaneous epithelium with underlying appendages (Plate 20); in most cases, however, the tumor contains elements derived from all three germ layers. In almost 2% of the cases and particularly in older women, dermoid cysts undergo a secondary malignant change, usually in the form of squamous cell carcinoma, but occasionally as an adenocarcinoma, sarcoma, or other type of malignant neoplasm.

The best known of the monodermal and highly differentiated teratomas is the struma ovarii, or thyroid tumor of the ovary. Thyroid tissue can be found in the wall of over 10% of dermoid cysts, but it is only when this type of tissue forms a grossly recognizable component of the specimen or is the predominant element microscopically that the designation struma is used. Struma ovarii occurs most commonly in pure or almost pure form, but often it is associated with a dermoid cyst or another type of teratomatous proliferation. Rare strumas have a malignant appearance microscopically, simulating follicular or papillary carcinomas of the thyroid gland. On very rare occasions, struma ovarii contributes to the development of hyperthyroidism.

The carcinoid tumor is a relatively common form of monodermal and highly specialized teratoma. It may be

of several types: insular or midgut, trabecular or hind-gut, and mucinous. Approximately one-third of insular carcinoids are hormonally active and result in the development of the carcinoid syndrome, which can usually be cured by removal of the tumor. In most cases of primary carcinoid of the ovary, other teratomatous elements can be found on microscopic examination of the specimen. Still another monodermal teratoma of great interest is the strumal carcinoid, in which struma and carcinoid coexist in the same specimen, commonly becoming intimately admixed with one another. Other monodermal teratomas include primary malignant melanomas, sebaceous gland tumors, retinal anlage tumors, and primitive neuroectodermal tumors. The last group of neoplasms are probably more common in young women than generally realized, but are not recognized because they can closely simulate common epithelial carcinomas on microscopic examination (6,7).

A very unusual type of teratoma is the fetiform teratoma, or homunculus, a neoplasm that has the gross appearance of a fetus, but is generally composed mostly of skin and connective tissue, with only rudimentary development of the gastrointestinal tract, spine, and central nervous system.

An important but relatively rare subtype of germ cell tumor is the primitive mixed germ cell tumor, containing various admixtures of dysgerminoma, yolk sac tumor, teratoma, choriocarcinoma, and embryonal carcinoma.

Gonadoblastoma and Related Tumors

The gonadoblastoma is composed of germ cells, sex cord derivatives, and usually stromal derivatives, and arises almost always in the dysgenetic gonads of individuals who have undergone abnormal sexual development. In half the cases, the germ cell component of the tumor infiltrates the stroma to form a dysgerminoma or seminoma (Plate 21), and in 5 to 10% of the cases it gives rise to a more highly malignant form of primitive germ cell tumor. Extremely rare tumors simulating the gonadoblastoma in their content of germ cell, sex cord, and stromal derivatives develop in otherwise apparently normal females. These tumors are referred to as germ cell-sex cord-stromal tumors, unclassified.

Unclassified Tumors

Occasionally, as in other organs, one encounters ovarian neoplasms that defy classification. Several types of tumor in this category have been characterized pathologically and clinically since the publication of the WHO classification. The ovarian tumor of probable wolffian origin (8) is composed typically of nonmucin-secreting, generally well-differentiated epithelial cells that are arranged diffusely, in the form of cords or tubules or in a cystic sievelike pattern. These tumors are presumed to be of wolffian origin because they do not closely resemble ovarian tumors of mullerian type, but simulate one of the most common epithelial tumors of the broad ligament, which has been designated female adnexal tumor of probable wolffian origin.

A second type of previously unclassified tumor that has been recently characterized is the small cell carcinoma with hypercalcemia (9), a highly malignant tumor of young females. This tumor is composed most commonly of small cells of epithelial type containing scanty cytoplasm (Plate 22). In most cases the patient has paraendocrine hypercalcemia that recedes after removal of the tumor. The histogenesis of this neoplasm is unclear.

Tumorlike Conditions

The pregnancy luteoma is encountered rarely during pregnancy, primarily in the third trimester, in the form of single or multiple nodules composed of lipid-poor cells of lutein type. The nodules may attain 20 to 30 cm in diameter and are often bilateral. In one-quarter of the cases there is evidence of virilization of the mother, and in a smaller number of cases, virilization of the female fetus. The regression of pregnancy luteomas after the termination of pregnancy indicates that they are not neoplastic but hyperplastic nodules dependent on the hCG level of pregnancy for their structural and functional integrity.

Stromal hyperplasia is a common bilateral ovarian lesion that occurs most often in menopausal and early postmenopausal women. When luteinization has developed focally in the hyperplastic stroma, the designation stromal hyperthecosis is used. Both lesions may enlarge the ovaries sufficiently to simulate tumors. Stromal hyperthecosis may be associated with virilization, hypertension, obesity, and impaired glucose tolerance. Rarely, one or both ovaries become massively edematous in a child or young woman, simulating even more closely a neoplasm. In a minority of cases of massive edema, luteinized cells are found in the edematous stroma, and their presence is usually associated with androgenic manifestation.

Solitary follicle cysts are common, particularly in young women, and may be confused clinically with ovarian tumors until they regress spontaneously. Polycystic ovaries are characterized by multiple follicle cysts, collagenization of the outer cortex, and an absence or paucity of corpora lutea and corpora albicantia. The accompanying clinical disorder is known as polycystic ovarian disease or the Stein-Leventhal syndrome, and is characterized by infertility, oligomenorrhea or amenorrhea, and frequently, hirsutism. Hyperreactio luteinalis is characterized by the presence of multiple luteinized follicle cysts occurring during any of the trimesters of pregnancy, particularly in association with trophoblastic disease of the uterus and high levels of hCG. The condition is bilateral, and the ovaries may range up to 20 to 30 cm in diameter. An iatrogenic form of this condition is produced by treatment of an infertile patient with ovulation-inducing drugs. In the iatrogenic disorder, multiple corpora lutea may be seen in addition to the lutein cysts.

Ovarian endometriosis usually occurs in the form of microscopic foci (Plate 8), but occasionally repeated bleeding results in the formation of a large endometriotic (chocolate) cyst filled with old blood and lined by endometriotic tissue, which is often replaced by dense fibrous tissue containing blood pigment. Rarely, malignant tumors of a variety of types originate from ovarian endometriosis.

Other ovarian lesions that simulate tumors are simple cysts, that is, cysts whose linings have been destroyed so that their origin is no longer recognizable, and a variety of inflammatory lesions, some of infectious origin.

APPENDIX 1: HISTOLOGICAL CLASSIFICATION OF OVARIAN TUMORS

I. COMMON EPITHELIAL TUMORS

A. Serous Tumors
  1. Benign
    a. Cystadenoma and papillary cystadenoma
    b. Surface papilloma
    c. Adenofibroma and cystadenofibroma
  2. Of borderline malignancy (carcinomas of low malignant potential)
    a. Cystadenoma and papillary cystadenoma
    b. Surface papilloma
    c. Adenofibroma and cystadenofibroma
  3. Malignant
    a. Adenocarcinoma, papillary adenocarcinoma, and papillary cystadenocarcinoma
    b. Surface papillary carcinoma
    c. Malignant adenofibroma and cystadenofibroma

B. Mucinous Tumors
  1. Benign
    a. Cystadenoma
    b. Adenofibroma and cystadenofibroma
  2. Of borderline malignancy (carcinomas of low malignant potential)
    a. Cystadenoma
    b. Adenofibroma and cystadenofibroma
  3. Malignant
    a. Adenocarcinoma and cystadenocarcinoma
    b. Malignant adenofibroma and cystadenofibroma

C. Endometrioid Tumors
  1. Benign
    a. Adenoma and cystadenoma
    b. Adenofibroma and cystadenofibroma
  2. Of borderline malignancy (carcinomas of low malignant potential)
    a. Adenoma and cystadenoma
    b. Adenofibroma and cystadenofibroma
  3. Malignant
    a. Carcinoma
      i. Adenocarcioma
      ii. Adenoacanthoma
      iii. Malignant adenofibroma and cystadenofibroma
    b. Endometrioid stromal sarcomas
    c. Mesodermal (müllerian) mixed tumors, homologous and heterologous

D. Clear Cell (Mesonephroid) Tumors
  1. Benign
  2. Of borderline malignancy (carcinomas of low malignant potential)
  3. Malignant: carcinoma and adenocarcinoma

E. Brenner Tumors
  1. Benign
  2. Of borderline malignancy (proliferating)
  3. Malignant

F. Mixed Epithelial Tumors
  1. Benign
  2. Of borderline malignancy
  3. Malignant

G. Undifferentiated Carcinoma

H. Unclassified Epithelial Tumors

II. SEX CORD STROMAL TUMORS

A. Granulosa-Stromal Cell Tumors
  1. Granulosa cell tumor
  2. Tumors in the thecoma-fibroma group
    a. Thecoma
    b. Fibroma
    c. Unclassified

B. Androblastomas, Sertoli-Leydig Cell Tumors
  1. Well-differentiated
    a. Tubular androblastoma, Sertoli cell tumor (tubular adenoma of Pick)
    b. Tubular androblastoma with lipid storage, Sertoli cell tumor with lipid storage (folliculome lipidique of Lecene)
    c. Sertoli-Leydig cell tumor (tubular adenoma with Leydig cells)
    d. Leydig cell tumor, hilus cell tumor
  2. Of intermediate differentiation
  3. Poorly differentiated (sarcomatoid)
  4. With heterologous elements

G. Gynandroblastoma

D. Unclassified

III. LIPID (LIPOID) CELL TUMORS

IV. GERM CELL TUMORS

A. Dysgerminoma

B. Endodermal Sinus Tumor

C. Embryonal Carcinoma

D. Polyembryoma

E. Choriocarcinoma

F. Teratomas
1. Immature
2. Mature
a. Solid
b. Cystic
i. Dermoid cyst (mature cystic teratoma)
ii. Dermoid cyst with malignant transformation
3. Monodermal and highly specialized
a. Struma ovarii
b. Carcinoid
c. Struma ovarii and carcinoid
d. Others

G. Mixed Forms

V. GONADOBLASTOMA

A. Pure

B. Mixed with Dysgerminoma or Other Form of Germ Cell Tumor

VI. SOFT TISSUE TUMORS NOT SPECIFIC TO OVARY

VII. UNCLASSIFIED TUMORS

VIII. SECONDARY (METASTATIC) TUMORS

IX. TUMORLIKE CONDITIONS

A. Pregnancy Luteoma

B. Hyperplasia of Ovarian Stroma and Hyperthecosis

C. Massive Edema

D. Solitary Follicle Cyst and Corpus Luteum Cyst

E. Multiple Follicle Cysts (Polycystic Ovaries)

F. Multiple Luteinized Follicle Cysts and/or Corpora Lutea

G. Endometriosis

H. Surface-Epithelial Inclusion Cysts (Germinal Inclusion Cysts)

I. Simple Cysts

J. Inflammatory Lesions

K. Parovarian Cysts

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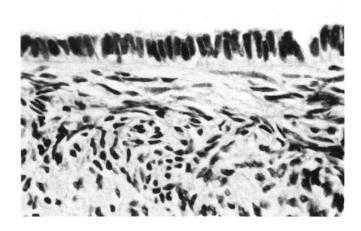
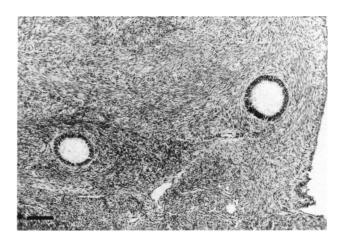PLATE 1. Columnar surface epithelium overlying stroma. Bar = 0.021 mm.

PLATE 2. Surface epithelial inclusion glands within ovarian stroma. Bar = 0.233 mm. Reprinted with permission (2).
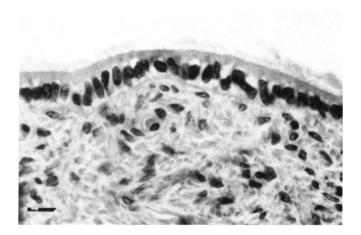

PLATE 3. Serous cystadenoma, with ciliated epithelium overlying stroma derived from ovarian stroma. Bar = 0.026 mm.
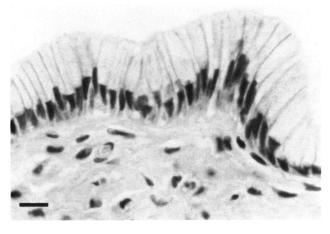

PLATE 4. Mucinous cystadenoma, with mucin-filled epithelial cells overlying stroma derived from ovarian stroma. Bar = 0.026 mm. Reprinted with permission (2).
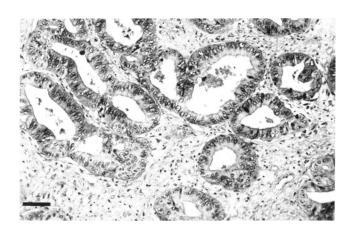

PLATE 5. Endometrioid carcinoma composed of glands lined by endometrioid nonmucin-containing epithelium. Bar = 0.175 mm. Reprinted with permission (10).
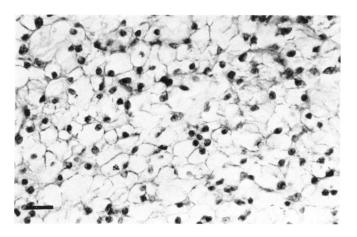
PLATE 6. Clear cell carinoma composed of large clear cells, which were filled with glycogen. Bar = 0.084 mm. Reprinted with permission (11).
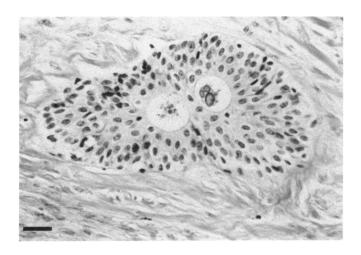
PLATE 7. Brenner tumor, with nest of transitional cells containing a central secretion-filled cavity lying in a stroma derived from ovarian stroma. Bar = 0.060 mm.

PLATE 8. Adenofibroma composed of glands embedded in predominant stroma derived from ovarian stroma, lying adjacent to endometrium containing endometrioid glands and cellular endometrioid stroma. Bar = 0.382 mm. Reprinted with permission (2).
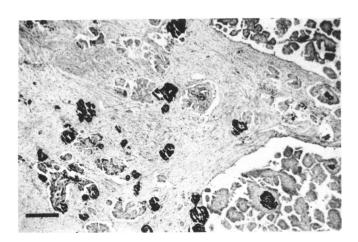
PLATE 9. Serous papillary carcinoma, with intracytic papillae and invasion by small papillae, many of which have been replaced by calcific masses. The stroma of the invasive tumor is desmoplastic. Bar = 0.420 mm. Reprinted with permission (12).
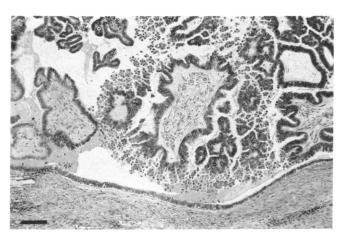
PLATE 10. Serous papillary cystadenoma of borderline malignancy. Cellular buds appear to be detached from the papillae and to float in the lumen; there is no invasion of the underlying stroma. Bar = 0.262 mm. Reprinted with permission (2).
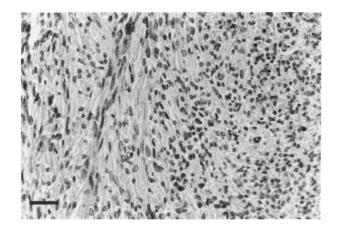
PLATE 11. Fibroma with intersecting fascicles of spindle cells that have produced collagen. Bar = 0.065 mm. Reprinted with permission (*2*).
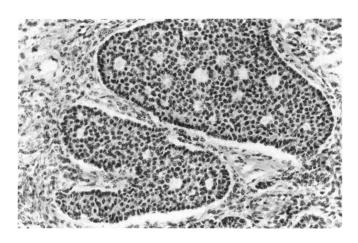
PLATE 12. Granulosa cell tumor, microfollicular pattern, characterized by cells with pale, round nuclei and scanty cytoplasm arranged around small cavities (Call-Exner bodies). Bar = 0.105 mm. Reprinted with permission (*2*).
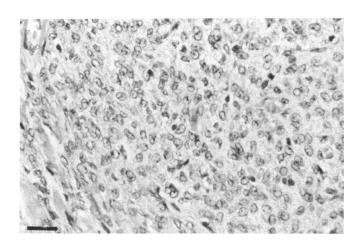

PLATE 13. Thecoma, characterized by cells with abundant pale vacuolated cytoplasm. Bar = 0.055 mm. Reprinted with permission (*13*).
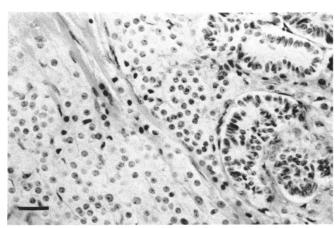
PLATE 14. Well-differentiated Sertoli-Leydig cell tumor, with tubules lined by columnar Sertoli cells and interstitial masses of Leydig cells. Bar = 0.070 mm.
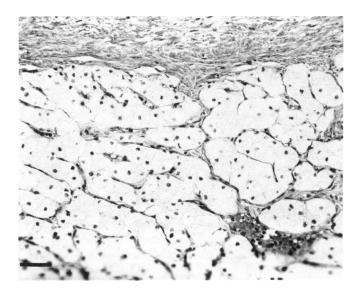
PLATE 15. Steroid cell tumor containing large lipid-filled cells of steroid type. Bar = 0.084 mm.
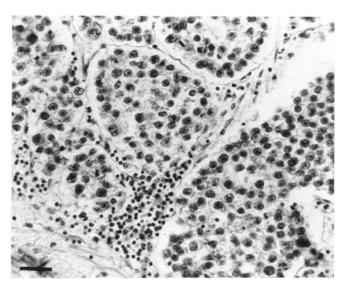
PLATE 16. Dysgerminoma composed of large clear (glycogen-filled) cells with central nuclei. The characteristic lymphocytic infiltration of the stroma is present focally. Bar = 0.077 mm. Reprinted with permission (14).
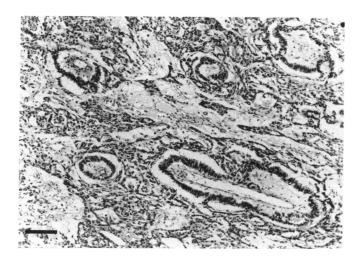

PLATE 17. Endodermal sinus tumor with single papillary projections (Schiller-Duval bodies) lying within spaces. Bar = 0.262 mm. Reprinted with permission (2).
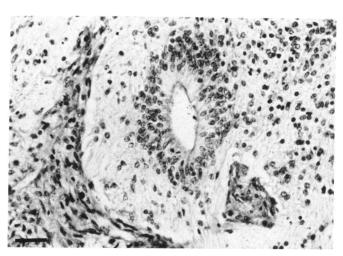

PLATE 18. Immature teratoma containing cellular glia and neuroepithelial rosette. Bar = 0.076 mm. Reprinted with permission (15).
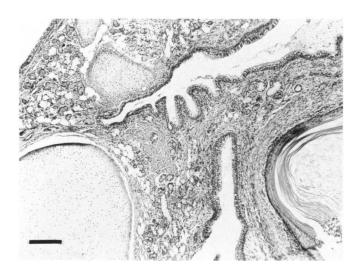
PLATE 19. Mature teratoma containing cartilage, cysts lined by respiratory epithelium, and keratinizing squamous nest. Bar = 0.420 mm. Reprinted with permission (2).
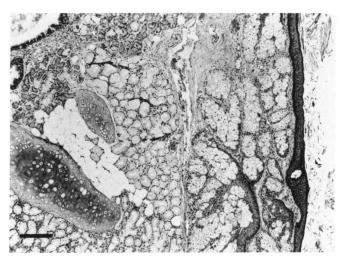

PLATE 20. Dermoid cyst lined by skin with underlying appendages, salivary gland tissue, fat, and cartilage. Bar = 0.420 mm. Reprinted with permission (2).
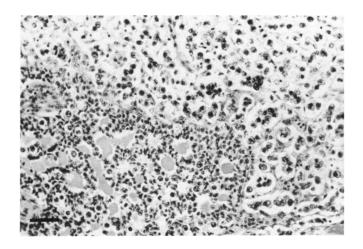

PLATE 21. Gonadoblastoma (left) and dysgerminoma (right). The nest of gonadoblastoma contains large germ cells and small cells of sex cord type surrounding small cavities. Bar = 0.131 mm. Reprinted with permission (2).
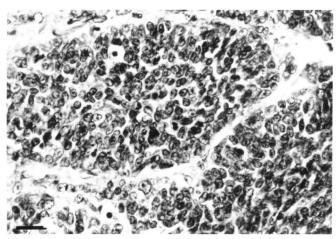

PLATE 22. Small cell carcinoma composed of nests of small cells of epithelial type with scanty cytoplasm. Bar = 0.053 mm.